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ABSTRACT

Three essays on the ways in which colleges and universities use the computer as a teaching tool are presented, along with descriptions of 10 school programs that reflect the diversity of computer applications across the United States. In "A Place for Computing in Liberal Education," Karl L. Zinn likens the computer to personal resource tools, such as typewriters; cautions against making computing procedures more complicated than they need to be; and concludes that computers have a place in liberal education. In "Computers and Liberal Education in the Humanities and Social Sciences," Richard R. Johnson describes how computing technology will affect teaching in the humanities and social sciences. He believes that computers will have a positive effect on education and, in some applications, can bring people together more than books do. In "Computer-Based Teaching and the Sciences," Stanley Smith focuses on the ways in which computer-assisted instruction already is helping students in the sciences gain a better understanding of course materials. Program descriptions are given for the following: the Academic Computing Program at Grinnell College, computer-assisted instruction in religious studies at California State College at Bakersfield, computer-assisted instruction in music theory at Northern Kentucky University, the Office of Computer-Based Instruction at the University of Delaware, computers and elementary modern standard Arabic at the University of Texas at Austin, academic computing at Goucher College, a computer-assisted sociology course at Rensselaer Polytechnic Institute, computer-assisted instruction in Technical Terminology at the University of Minnesota, computer-based education at Metropolitan State University, and computer-assisted instruction in statistics at Beaver College. Additional programs are briefly described. (SW)

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Computer-Based Learning

This issue of The Forum for Liberal Education *examines the ways in which colleges and universities are employing the computer as a teaching tool. Our three essayists explore computer-based learning from their own perspectives. Karl Zinn likens the computer to those personal resource tools such as typewriters, that we already own. He cautions against making computing procedures more complicated than they need to be and concludes that computers have a place in liberal education.*

In his essay, Richard Johnson describes how computing technology will affect teaching in the humanities and social sciences. He believes that computers will have a positive effect on education and, in some applications, can bring people together more than books do. Stanley Smith focuses on the ways in which computer-assisted instruction already is helping students in the sciences gain a better understanding of course materials. Computers, he says, go beyond the standard textbooks and laboratory, to provide students with a new tool for understanding and developing concepts.

The ten schools featured in this issue reflect the diversity of computer applications across the country. In some of the articles we have concentrated on a particular department's use of computers. Other articles describe the comprehensive programs being implemented at the schools.

A Place for Computing in Liberal Education

by Karl L. Zinn
Research Scientist
Center for Research on Learning and Teaching
University of Michigan

Computers haven't been around for very long but already we are hearing about schools providing general "literacy" in computer use for all students, and colleges offering personal computers on loan or rental programs if entering students don't already own them!

Clearly students need to learn about computers and automated information processing: the machines will inappropriately dominate our lives otherwise. Furthermore, computing is an appropriate subject of instruction for many professions and careers. However, I want to call attention to the role of computers in learning and scholarly work: What is the place for computing in liberal education?

Professors from a variety of colleges and disciplines are providing interesting answers. Some you'll find mentioned in this issue. The ideas that most impress me have something to do with access, initiative, and responsibility. Students are gaining much greater access to information through computer assistance. Furthermore, the machines and the associated communication facilities provide a facility for testing models and algorithms, and for sharing commentary with others. Students take new initiative in problem solving and creative

work, encouraged by computer assistance. And the resources opened up by computers and telecommunications encourage — even require — students to take more responsibility for their own learning.

Richard Johnson mentions in this issue the computer in humanities and social sciences as a "super" typewriter, calculator, telephone, laboratory, and library. Similarly, I find it useful to think about the student as a scholar — retrieving and organizing information, analyzing data, and testing hypotheses — and as a member of a community of learners, participating in research, discussion, and publishing. Another useful approach considers the college learning environment. The personal computer and related services will be very ordinary resources in the future as contrasted with the special attention given today. We should be anticipating a time when nearly all college students and teachers do computing and handle information in a familiar and personal way.

When planning for personal computer use, I like to consider the personal aids students now have in their residences and communities. This exercise helps me maintain perspective on the requirements for effective personal use of computers. Surely the introduction of new technology should not cause us to give up things we value, not even small considerations of convenience and comfort.

A personal typewriter is available on demand. A portable one is carried to the library, a carrel, and outside on the lawn. Consider the frustration some people experience when they have to type a report on an unfamiliar machine. Sometimes the preferred typwriter is shared, but conflicts do develop, and a personal machine is preferred. Some students get along using a "public" typewriter located in the library or other central location. However, these machines seem to break down when you need them most. A few students regularly depend on others to do their typing, and nearly all students occasionally call on special production services. Personal typing is only a small part of potential personal computer use, but an important contribution to writing if the technical assistance meets your criteria (for example, the computer must be portable, convenient, reliable, and backed up by production services.)

Students have personal writing desks, with supplies and shelf storage arranged according to personal preference. The desk in one's residence or carrel in a shared working area provides a situation for study and scholarly work. I do my best when I have my accustomed supplies at hand, access to notes and previous reports, and am in my familiar place of work. I expect a portable, personal computer — one which can link up with information stored at other sites, and communicate with colleagues through electronic mail — will help me to carry some of that familiar working situation with me wherever I go, much more than presently with my portable computer terminal. Incidentally, I assembled this essay from some other articles while flying across the country. During a wait between planes I connected by portable terminal to a pay phone, dialed the local number of a national data network, directed communication to the Michigan network, addressed my university's computer, and retrieved some additional text for possible use.

Entertainment and recreation are personalized now through pocket radios, audio cassette recorders, and portable stereo systems. Even video cassette recorders and videodiscs are not uncommon in student rooms. I find it instructive to talk with students about what they are willing to pay for personal equipment, and what they expect it to do for them. Enough students now have personal computers for recreational and hobbyist activities that we get some ideas about computer acquisitions directly. The combination of videodisc (for storage of digital as well as video information) with personal computers has great potential for inexpensive learning resources. I expect the secondary use for entertainment increases the likelihood students will have these resources available for learning.

Libraries and bookstores are personalized in interesting ways also. Personal browsing is encouraged in some, and there it is more common than systematic retrieval of documents. Personalized advice from staff is evident in the preferred bookstores, and advice from peers is common and sometimes preferred to staff assistance. Within five years, computer-based information services accessed by personal computers will be used regularly for browsing, personalized advice, and peer discussions.

Personal computing and information handling as a part of study and scholarly work will fit into all of these situations! I'll comment briefly on one more domain of personal aids which is not given the attention it deserves.

Communication aids for handicapped students may be the most significant contribution of microcomputers to education in this decade. Those with impaired sight or hearing find significant supplements and other aids in personalized microcomputer systems. And those with severe handicaps restricting voice, writing, or memory find the new technologies can give them vocal communication, composition aids, or help with organization of notes.

An important point to make is that the same electronics technology that helps us communicate for pleasure or for business may be a necessity for someone who has been denied some basic medium of communication such as speech. But further, and this is more subtle, what is learned from helping those with severe handicaps often can be applied to helping the rest of us with our minor handicaps.

As college teachers we need to get beyond computerized tutorials, tests, and games to provide direct access to information under the control of the learner. We need to go beyond computer-based simulations to provide the facility and guidance for modeling and for analyzing processes and data. We need to work hard to avoid our tendency to introduce unnecessary complexity, it's possible to keep computing procedures obvious, even visual. And we must guard against becoming mechanistic or arbitrary or otherwise letting the technology dominate the learning and creative activity. Computers are for people to use in ways they choose, including learning and scholarly work, and they have a proper place in liberal education.

Computers and Liberal Education In The Humanities and Social Sciences

by Richard R. Johnson
Research Director
Exxon Education Foundation

There was a time when instruction was mostly made up of oral interchanges between apprentices and a master teacher. Then came the widespread availability of books,

and the process of education changed. The introduction of a new technology, printing, made possible new ways of teaching and learning. Much of the old process still remains — it is still common to lecture and to engage students in discussion — but it is clear that the widespread availability of books fundamentally changed the teaching process. In the next two decades computer technology will have a similar impact on the teaching of the liberal arts.

Computers have been around for quite a while now without revolutionizing education in the way that some had predicted. But there is presently reason to believe that the gradual incursion of the technology will accelerate dramatically. The Gutenberg revolution did not occur with the invention of printing. It came over 200 years later with the widespread availability of books. In the last few years a similar trend has begun with computers as dramatic decreases in costs and the development of microcomputers have put the technology within reach of everyone.

I propose to list briefly some of the present uses and coming extensions of the technology that I feel will most affect teaching in the humanities and social sciences. First, however, I need to point out the place the technology will have in the total teaching environment. The advent of the new technology embodied in the book did not eliminate teachers to leave students sitting with noses buried in books. We will not be firing faculties to have colleges become places for students to spend hours over a keyboard while peering at a television screen. Computers will take their place among other resources while many of the old and tried teaching techniques remain. But at the same time, the total educational process will have changed in fundamental ways.

* * *

The Computer As a Super Calculator. The capacity of computers to collate large amounts of information and perform complex logical and mathematical operations in fractions of a second has extended teaching possibilities in the social sciences. Students can be involved in learning projects which have more scope and reality. The present applications in economics, sociology, psychology, and political science will be extended rapidly. Humanities fields will use this potential as the teaching methods begin to follow the present leads of computerized humanities research. This latter trend, however, will be far slower.

The Computer As a Super Tutor. Computer-assisted instruction, drill and practice, and computerized testing will expand directly into all social science and humanities fields about as rapidly as the technology becomes available. Some have argued that availability of computer programs will limit these applications, but with the development of new authoring languages, it will become commonplace for individual faculty members *and students* to write their own short programs. The fact that third-graders are presently teaching themselves programming at some experimental sites and that learning to program is far easier than learning to drive a car, suggests that teachers will begin using this tool as they see its utility in their own teaching. While the widespread production of computer software raises issues about quality control, these are the same problems we neglect today when we fail to question individual teacher's syllabi, course assignments and tests. What is possible with the transfer of some of these teaching documents to the computer is that good techniques will drive out some of the bad as programs are shared and "published."

The Computer As a Super Typewriter. Word processing equipment is changing the nature of composing and editing written material. What have been separate and parallel expressions of the technology in computers and word processors will merge in the future into more general purpose machines. This will mean that teachers can expect all student papers to be typed and, since the student's terminal or microcomputer will have an editing facility, papers should be in *neat, final form.* Furthermore, because of the ease of student editing, teachers will be able to require rewriting of the material without imposing undue hardship. Since we know that one of the major factors distinguishing good writers shows up in editing and reworking written material, extended practice in writing should help instruction in this area. In addition, already existing computer programs which check spelling, punctuation, and grammatical structure could pre-screen student papers for grading on these more mechanical skills. This would leave the teacher free to focus on higher order issues such as the development of arguments, the relationship of ideas, and the style of writing. This use of the technology will spread rapidly with the availability of equipment.

The Computer As a Super Laboratory. Computer simulation has rapidly become more sophisticated. Educational uses will include both computer-generated and computer-controlled (e.g., using video disc storage) means to present analogs to educational experiences in laboratory and field work. Developments of this use, however, will be slower since they will be more limited by cost and hardware constraints, particularly for simulation of complex environments. Most of the applications will be in the social sciences.

The Computer As a Super Blackboard. Computer graphics have many applications in the display of complex information, especially when the information needs to be transformed while one is teaching. Other applications include artistic productions. This use of computers should expand rapidly, particularly in some areas of the social sciences.

The Computer As a Mini-Library. Experiments using computers to store hypertext are already over five years old. Enormous storage capacity and rapid retrieval of information make computers an excellent vehicle for structuring information. Ideally, any teacher might have his or her own "library" organized by its own modification of Dewey Decimal or Library of Congress structure. In such a library any footnote inserted in any item could immediately be used to locate and retrieve the other item. In addition, one could ask for all of the books or items related to "X" and have this electronic reference librarian look them up and report. Reality will lag behind the ideal for some time, largely because of the costs of "filing" items in such a library. However, more limited-scope, structured databases like this will become more common in most fields.

The Computer As a Super Telephone. Computer conferencing does not merely involve typing instead of talking over the telephone. Its utility goes well beyond getting past a busy signal when you want to tell someone something. It is more like a group of individuals creating the "mini-library" mentioned above. Queries, comments, and replies are linked to each other. Individuals can join in or observe on their own schedule, knowing that the information will be there. The final result, perhaps edited or structured differently by different participants, can be a paper, conclu-

sion, or plan which would have been difficult for the group to produce over several telephone conversations or even via an extended face-to-face meeting. In teaching this will be used to promote student discussion of subject matter and commentary on course materials among students and between student and teacher. What is perhaps most significant about this application, however, is the fact that the computer is not an anti-humanistic tool. Even more than the book, the computer, in some of its applications, can draw people together to work on common tasks.

The list of potentially positive effects on teaching mentioned above will not come about automatically with the introduction of the technology. Just as there are many books extant that were not worth publishing, we will have to suffer with some computerized trash. But in the long run, I am sure that our judgment on this newer technology will be similar to our feelings about that older, print technology. It will have fundamentally changed our teaching in the liberal arts in ways we will not want to give up.

Computer-Based Teaching and the Sciences

by Stanley Smith
Professor of Chemistry
University of Illinois

Computer-based teaching in the sciences is more than tests, quizzes, and drills managed by a computer. It provides both the the instructor and the student with a powerful tool for introducing and developing new concepts and for simulating experiments. The computer can be viewed as an interactive medium in which the instructor engages a student in a dialog in order to practice and develop theories and hypotheses and to introduce new ideas.

Computer-assisted instruction (CAI) has been used at the University of Illinois for the past decade to help students learn such diverse subjects as chemistry, physics, Russian, French, and computer science. The PLATO® system, which was first developed at the University of Illinois in the early 1960s, has been used in these studies.

The computer is used in a wide variety of ways to help students learn. For example, in one organic chemistry course students work about three hours per week on the computer. The computer provides tutorial development of new ideas, simulations of experiments, and practice problems. The work on the computer supplements what can be done with textbooks, lectures, and laboratory work. This integration of traditional teaching methods with computer techniques can result in higher student morale and better performance in laboratory work and on exams. Based on hundreds of thousands of hours of use in real classes it is clear that, with suitable programs, students like using the computer and feel that it helps them learn the material faster.

For example, students in an inorganic chemistry course, which used the computers as a required part of the curriculum, were asked to grade lectures, the textbook, and the computer on "how much it helped you learn the material." While 77 percent of the students gave the computer an "A," lectures received an "A" from only 33 percent of the students, the textbook from only 10 percent. Similar results have been obtained by Professor Bruce Sherwood in his computer-based physics course on classical mechanics at the University of Illinois.

In addition to the obvious advantages of allowing students to interact with the instructional material at their own rate and at a time convenient to them, CAI programs allow students to practice experiments before going to the laboratory. These laboratory simulations can improve the effectiveness of laboratory instruction. Experiments which are too complex, dangerous, or expensive can be simulated on the computer. This allows students to perform for themselves the classic experiments which support the theories developed in lectures. Other types of programs allow students to practice their problem-solving skills with programs which recognize a wider range of approaches than is possible with traditional printed material.

Because the computer can duplicate its interactions with each student, it is a useful tool for educational research. The instructor is able to collect statistical data on how students react to a specific program, modify the instructional materials, and collect additional data on how the students respond to the modifications. The application of the computer in comparing the effectiveness of various instructional techniques may lead to better instructional strategies.

General use of computer-based instructional techniques in colleges and universities requires the development of many more programs than are currently available and a low cost way to deliver them. The rapid development of relatively inexpensive microcomputers, which have the capability to deliver highly interactive instructional material, may lead to the necessary development of instructional material by skilled teachers. Computers can then take place alongside blackboards and textbooks as a tool to help teachers and students.

Grinnell College
Academic Computing Program

The academic computing program at Grinnell is having a pervasive and a dynamic effect on educational life at the college, according to Thomas Moberg, director of academic computing. Both the administration and the faculty view computing as an educational resource analogous to the library. Students accept the computer as part of their college experience, and the school is actively promoting computer literacy for all students.

Less than seven years ago the attitudes on campus were not as supportive. There was a general antipathy towards computers, and few faculty were involved in computing. In 1968 the college became part of the Regional Computer Center which provides access to the computing facilities of the University of Iowa. The computing facilities at that time were located several blocks from the campus, and processing was done by batch. Recognizing that students in every academic discipline should have an understanding of computer concepts, the administration demonstrated its

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support for the academic computing program by purchasing a Digital Equipment Corporation PDP 11/45 interactive computer system in 1975. The computer services office was moved on campus, and terminals were placed in various campus locations.

The expansion of computer services at Grinnell strengthened the administration's commitment to computer literacy for all students. Computer literacy is defined in the college catalog as "familiarity with computing concepts and an understanding of the impact computers are having on society." All students, faculty, and staff can obtain computer accounts simply by asking for them. Although the college does not require students to enroll in any computer literacy courses, the administration employs a variety of methods to provide all students with a knowledge of computers. These include the addition of computer-related materials in courses, workshops on computer usage, and one-on-one contact with faculty.

Moberg has discovered that approximately 30 percent of Grinnell's incoming students know something about computers before entering college. For those students who are not familiar with computers, advisers recommend Math 115, Introduction to Statistics and Math 101, Computer Programming. Each year approximately 150 students from a wide range of disciplines enroll in Introduction to Statistics. The course focuses on modern statistical practice which relies heavily on computing. Faculty from the departments of psychology, sociology, mathematics, economics, and political science teach various sections of the course. Each section employs computer-based exercises and programs to illustrate such concepts as sampling theory, laws of probability, and asymptotic theorems. The 200 undergraduates enrolled in Computer Programming each year learn to program in the BASIC language. Moberg says that students have recognized the value of statistical, quantitative, and computer skills for any major and are enthusiastic about these courses.

In 19 of Grinnell's 23 academic departments there is at least one faculty member who uses the computer for teaching or research. Since 1974 the administration has emphasized hiring faculty who are computer-oriented and computer literate. Departmental computer applications include grammar and vocabulary drills in Spanish, Russian, German, and French; counseling simulations in education; and statistical data analysis in anthropology, mathematics, and political science. In Introduction to French Literature, for example, students use locally-written text analysis programs to study French poetry. The Archeological Interpretation course employs cluster analysis software to study relationships among archeological artifacts.

Students and faculty also may learn or improve computing skills through publications and workshops provided by the computer services staff. The freely-available publications serve as user-oriented introductions and guides to Grinnell's computing system. Moberg believes that an efficient and effective computing service must provide its users with easily obtainable information about software, hardware, and operating procedures. In addition, computer users can obtain assistance from the students who staff the main terminal room 100 hours each week. Grinnell also has an extensive on-line assistance system that is reached by simply typing HELP. The workshops, conducted by the staff, range from orientation sessions aimed at helping potential users overcome their basic fears of the computer to sessions designed to explain the computer graphics system to persons who know how to program.

Moberg believes that the computing program at Grinnell is successful in introducing all students to computing and in providing interested students with more advanced skills. This success can be measured by the statistics available on computer usage. During Spring 1981, 489 students, 41 percent of the total number of undergraduates, have computer accounts. Since the computing services staff removes all accounts at the end of each semester, this figure does not include those students who previously have used the computer but who do not have accounts this semester. These students are included in the records kept by the computing services office on the number of graduating seniors who have had computer accounts while they were at Grinnell. This figure has risen from 46 students in 1976, 17.5 percent of the graduating class, to 262 in 1980, 84.4 percent of the 1980 graduates. Student interest in computing also is demonstrated by the number of students who have utilized the computer for class projects and independent studies. For example, a group of students in a Sociology Methodology class used the computer in a data analysis of alumni attitudes concerning a college position paper on the future. As an independent project, an economics major designed computer-assisted instruction units for an introductory economics course. The student folk dancing group even uses the computer to store information about dances, music, and members' dancing abilities. In addition, students are employed as programmers and as user-consultants at the computer center. Many faculty also employ student assistants on research projects which have computer-related components.

Faculty response to the computer as a valuable resource in liberal arts education is very gratifying, according to Catherine Frazer, dean of the faculty. While faculty members in the sciences view computers as an accepted part of their teaching and research, humanities faculty members also are exploring the possible uses of computers in their disciplines. Moberg cites the examples of humanities faculty who are exploring the use of computers for creating set design and patterns in the theatre department and for developing a Polish root dictionary. Walter Stone, assistant professor of political science, finds Grinnell's computing system very useful in introducing students to social scientific research and in providing them with an appreciation of the strengths and limitations of the research process. His students are introduced to rudimentary methods of theory construction, measurement considerations, and a fundamental technique of data analysis. Students in Stone's Campaigns and Elections course, for example, analyze data on the 1976 presidential election. In the more advanced Field Methods in Political Science, the class chooses a specific topic and generates its own data to study and analyze. Class projects have included a study of the people who contribute to state legislative campaigns and an omnibus study of community attitudes.

According to Eugene Herman, professor of mathematics, the computer provides instructors with radically different methods of teaching and thus forces an instructor to analyze, from new points of view, what and how he or she teaches. Herman says that working in educational computing has been a valuable learning experience. He is currently in the process of developing algebra/trigonometry instructional programs as part of a collection that he anticipates may take the place of traditional pencil-and-paper

homework and testing in the subject area. Herman also has developed a set of standard graphics subroutes in BASIC and FORTRAN that allow any programmer of modest ability to write device-independent graphics programs.

It is this type of research and faculty involvement that exemplify the future of computing at Grinnell, according to Moberg. He finds that faculty, staff, and student programmers are much more aware of using structured design and programming techniques than they were just a few years ago. In addition, Grinnell has just received a grant of 11 Apple II computer systems from the Apple Computer Company. The departments of physics, chemistry, and psychology plan to integrate microcomputing into their courses with the new equipment. The administration anticipates that laboratory computing techniques will become a major part of the science laboratory program at all levels.

In addition, Grinnell is seeking funds to provide computer literacy workshops for all faculty members. By requiring all faculty to attend the workshops, the school is demonstrating its conviction that the new capabilities of information technology are a part of the broad context within which liberal arts education will continue to take its place, according to the dean of the faculty. Frazer comments that "faculty must in future days be as comfortable with the computer center as they presently are with libraries and laboratories, because all three will clearly be part of the educator's world."

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California State College at Bakersfield

Computer-Assisted Instruction in Religious Studies

Computer-assisted instruction (CAI) began at California State College at Bakersfield in 1975 when funds for its development were allocated by the office of the chancellor. Of the three departments that developed pilot projects — English, philosophy, and religious studies — only religious studies retains CAI.

Bruce Jones, associate professor of religious studies and a long time computer enthusiast, created CAI modules for two of his courses, RS 101, Introduction to Religion, and RS 302, The New Testament. Jones prepared for the project by attending a workshop on a cross-disciplinary computing at Stanford University, where he says he was the only representative of religious studies amidst a group of statisticians, social scientists, and business persons.

In RS 101, CAI has been especially helpful in familiarizing students with the complex terminology of certain Eastern religions. Three series currently exist. The first, called TRY, is strictly non-instructional. TRY is designed to make students feel comfortable when seated in front of a terminal. The other two programs, CASTE and STAGES, assist students in learning the vocabulary of Hinduism. CASTE outlines India's rigid social system; STAGES describes and details the four phases through which the ideal human life should pass. Questions are of the short answer format. Students are permitted to answer the computer in either English or Sanskrit, although if they respond correctly in English, the computer supplies them with the Sanskrit term.

TRY, CASTE, and STAGES were initially evaluated in 1976 after the first group of students had completed the course using CAI. On the final exam that year, Jones asked his students to write an essay on one of four topics which he provided. Two of the topics were the caste system and the four stages of life. Nearly 60 percent of the students taking the test chose to write about one or the other of these topics, indicating that they feel slightly more comfortable about material they have reviewed with the computer. No significant difference in grades among the four questions was reported. More concrete evidence for the programs' success was derived from a questionnaire distributed to students in RS 101 at the end of the term. Out of 30 students surveyed, 12 rated the computer exercises "very helpful" as an aid to learning, and 17 rated them as "fairly helpful." No students rated the exercises as "not too helpful" or "not helpful at all." The survey also indicated that the majority of the students who had used the computer once had returned to the terminal at least one more time. One student used all three of the programs six times each.

TRY, CASTE, and STAGES represent what Jones calls "classic CAI," in that the programs ask straightforward questions requiring specific answers. Jones' New Testament course makes more extensive use of the computer than Introduction to Religion. Here, the computer is used as an investigative tool, presenting evidence for students' consideration and clarifying issues involved in two New Testament textual problems. The first series of programs, called TIM, examines the three "pastoral" epistles, Timothy I, Timothy II, and Titus, for clues as to their authorship. Tradition ascribes all three letters to the Apostle Paul, although some twentieth-century scholars believe them to have been written much later than Paul's time by an unknown author. The computer presents passages from the three questionable books alongside passages from works known to be Paul's. Students compare and contrast grammatical structure and apply what they know of early church history to the conditions described in Timothy I, Timothy II, and Titus. At the end of the module, students present to the computer a carefully-considered argument for either Paul's or anonymous authorship of the three letters. Whatever position the students take, the computer raises objections and invites response.

A second New Testament program series, SYNOP by name, is concerned with the authorship of the first three gospels. Recent research indicates that the original account of Christ's life was that of Mark, which was used as a resource by the authors of Matthew and Luke. The computer juxtaposes passages from all three gospels dealing with the same event and assists students in formulating opinions on possible literary dependence. Students are expected to note verbal agreements and differences among the three versions of a story and decide whether the similarities are strong enough to suggest literary dependence.

Both TIM and SYNOP are more sophisticated than

TRY, CASTE, and STAGES as they demand a more complicated series of judgment. The college's PDP-11 minicomputer is equipped with the capacity to "read" and evaluate long responses by picking up key words and phrases and analyzing them in the context they are presented. Surveys indicate that a full two-thirds of students in The New Testament adequately understand the issues behind each of the programs after completing the CAI units. Six more units are in the planning stages.

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Northern Kentucky University
Computer-Assisted Instruction in Music Theory

Students interested in music as a profession, whether as teachers, composers, or performers, must learn the principles of music theory. Repeated drill and practice in this area are necessary so that students can automatically recognize and identify such elements of musical construction as intervals, scales, and chords. For this reason, the developers of Northern Kentucky's instructional program in theory found the computer an ideal tutor.

The developers, Gary Johnston and Bill Rost, assistant and associate professor of music, respectively, also found that music theory, because of its highly mathematical nature, was easily translated into computer languages. Two programs have been developed so far. The older of the two, which has been in operation for four years, uses the university's time-shared PDP 11/60 minicomputer to provide musical recognition and spelling drills. Johnston and Rost have written ten instructional modules to date, covering such elements of music theory as key signatures, intervals, scales, major and minor triads, and transposition. Questions such as "What is the key signature of E-flat minor?" and "How do you spell a minor triad on D?" flash onto the screen and students try to respond as quickly as possible. Such knowledge should become automatic. After students have answered a number of questions correctly, the computer rewards them by allowing them to play games with it.

The disadvantage of using the PDP 11/60 to teach music theory lies in the system's limitation to soundless instruction. With the aid of a grant from the Ortho Pharmaceutical Company, the music department recently purchased four APPLE II units that produce both high resolution graphics, very helpful when staffs are to be reproduced, and a variety of musical tones.

Students using the APPLE II listen to sequences of notes and attempt to identify characteristics of the way in which they are patterned. Individuals using the system can control the rate at which the notes are "played" as well as the number of tones contained in any sequence. The system also has different levels of questions keyed in, ensuring that students may not only work at their own rate, but within the bounds of their capabilities.

The music major at NKU requires four semesters of music theory. The CAI system, according to Johnston, is not intended to replace theory classes but to provide the repeated drilling that a sound theoretical knowledge requires. Students in the basic theory classes must solve between 50 and 100 problems each week on the computer. Both the PDP 11/60 and the APPLE II record the amount of time individual students spend at the terminals; instructors may check their progress through the exercises, although no exercises are graded. Johnston says that the 50-100 question weekly assignment is hardly unreasonable, as most students end up spending between three and ten times the amount of time required by their instructors.

CAI has also proved valuable to upper-level music majors. Johnston, who now teaches composition and orchestration exclusively, says that he frequently sends students back to the terminal so they can brush up on basic construction skills. Many students return of their own volition. The intrinsic value of the system lies in its infinite patience with both the slowest and most advanced students. The more advanced may progress through the exercises as rapidly as they wish, while slower students — the ones who might answer four or five questions in class per semester — receive the computer's undivided attention and assistance in sharpening their skills.

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The University of Delaware
Office of Computer-Based Instruction

Computer-based education is one of the areas in which the University of Delaware has chosen to excel, according to Fred Hofstetter, director of the Office of Computer-Based Instruction. The faculty view computing as a tool to use in the delivery of education and in improving instruction. Hofstetter, who is also an associate professor of music and educational studies, says that the emphasis of Delaware's computing program is on quality and excellence in instruction.

In the seven years that Delaware has been pursuing this goal, the office has compiled an impressive list of statistics. During the 1979-80 academic year 6,263 students in 90 courses used the university's PLATO system and spent a total of 40,290 hours at 130 terminals. The university has over 7,000 hours of lessons in 150 topic areas, and 75 faculty members in 30 different departments have authored PLATO lessons.

Delaware's program, according to Hofstetter, has never concentrated on the numbers of users. In 1974, when the Faculty Senate formed the Computer Application to Edu-

cation Committee, the faculty were interested in investigating and evaluating the potential value of educational computers in a university setting. As one of the areas in which the university had chosen to excel (the other areas include marine studies, the Institute for Solar Energy Conversion, and chemical engineering), computer-based education was carefully explored by the faculty to determine if the university could implement a successful and active program. In March 1975 the faculty began the Delaware PLATO project, which employs the Control Data Corporation PLATO system, to study computer education.

One of the committee's first tasks was to acquaint the faculty with how a computer-based educational system functions at a university. A group of faculty members representing 17 academic areas coordinated computer demonstrations for each of the areas, encouraged faculty to enroll in a seven-week seminar on author training, and solicited proposals from each college regarding the development of new PLATO programs or the implementation of existing courseware. During 1975 the committee approved the program development plans of ten departments. By fall 1976 six additional departments were planning to use the PLATO system, and the first large-scale use of PLATO began. The university continued to add terminals and personnel as the number of departments using PLATO grew. Based on this growth, the university decided to purchase its own PLATO system in 1978 rather than continue to lease services by means of long-distance communications lines.

The university's Office of Computer-Based Instruction, which evolved from the PLATO project, has a staff of over 70 employees. The staff includes Hofstetter, the director; associate directors of operations and administration; systems analysts; applications programmer/analysts; junior analysts; and trainee staff members. Many of the staff handle assignments in both program development and support services. In addition, staff members provide free seminar series that introduce the university community to PLATO, programming, and lesson design and review.

The centralized support staff and the faculty project leaders are the two main components in the organization of the PLATO project, according to Hofstetter. The project leaders are faculty members from each of the departments using PLATO who are identified by their departments as the person who will coordinate the department's computing priorities and PLATO activities. Each project leader is teamed with a staff programmer. The teams receive support through the centralized PLATO staff, which is independent of the academic departments. The responsibilities of each faculty project leader include serving as the intermediary between the department and the computer staff and evaluating the content of the department's PLATO lessons. The university has 38 faculty project leaders representing such areas as accounting, chemistry, instruction in education, aural skills in music, and mathematics. Hofstetter notes that the faculty leaders' energy, enthusiasm, and dedication have been an important factor in implementing PLATO at the university.

Sue Garton, Junior Applications Programmer/Analyst is the staff programmer assigned to the political science department. As a programmer she helps faculty get their ideas across on PLATO. Garton cites the example of a faculty member who is trying to help a student who has fallen behind in class. The instructor might check the PLATO project catalog to see if there are any lessons that this student might use to gain a better understanding of the class materials. The faculty member sees a need for a new subject and wants to develop a lesson. If the instructor has to take the time to learn to program, the lesson might not be developed. At the University of Delaware, the instructor with content knowledge can work with the programmer to get lessons on line.

The care taken in developing the university's computer-based education program has led to its success, according to Hofstetter. Among the 90 courses which employ PLATO are Introduction to Social and Cultural Anthropology, Anatomy and Physiology of Domestic Animals, Music Harmony, Volleyball, Botany I, and Philosophy of Love. In each of the courses the faculty employ various types of student and computer interactions to improve education. Through these interactions students can answer questions, ask for information, solve problems, manipulate drawings of objects on the screen, and make their own creative products such as graphic designs and music.

In the department of chemical engineering, for example, faculty have developed lessons which provide students with additional problem-solving skills. In the department of languages, faculty employ computer-based instruction in Latin, Spanish, French, German, and Ancient Greek courses. Students learning French use a word order lesson called *Touché*. In this drill the words of a sentence appear in scrambled order on the screen. By touching the words in the correct order, the complete sentence appears at the top of the screen and the English translation appears at the bottom.

The department of art is using PLATO to improve instruction in basic and graphic design. Students in Advertising Design create graphics using three of the computer-assisted lessons designed for the department by their instructor. Raymond Nichols, associate professor of graphic and advertising design, developed unit design, grey scale practice in tonal recognition, and optical letter spacing to help students practice various graphic techniques. Students using the unit design lesson, for example, create shapes with the aid of a computer by turning on or off dots on a 96 by 96 dot matrix. In the optical letter spacing lesson students practice arranging letters to achieve the most aesthetically pleasing and readable spacing. The PLATO system allows students to try different spacing without having to draw and ink the letters every time they want to make a change. In his advertising design course Nichols emphasizes the reaction of people to a design rather than focusing on the quality of execution. He says that students cannot always tell the difference between a poor idea done well and a good idea done poorly. With the computer every student has the same technical ability and his or her peers can concentrate on the design during critiquing sessions.

Nichols does not substitute the computer-assisted lessons for regular class instruction. His students develop hand skills using traditional methods. He is pleased that the system allows students to produce more designs. He estimates that with the computer students receive 20 to 30 times more practice in creating images than they would if they had to draw each design by hand.

Richard Sylves, assistant professor of political science, is developing a different type of computer application with the aid of a National Science Foundation Local Course Improvement (LOCI) grant. Sylves is designing four public policy simulations to assist students in developing genera-

lizations, testing theories, and perfecting models of the policy process. In the simulations students role-play the positions of congressional committee chairperson managing a bill, federal department executive with budgetary responsibilities, state environmental grants administrator with political and ecological concerns, and state political official during a legislative redistricting.

Students using the environmental policy stimulation, for example, must approve or reject municipal water treatment construction grant applications. They must consider each application based upon certain conditions of eligibility and federal and state funding. During the simulation the students must also contend with partisan influence, committee pressures, legislator seniority, and accountability to the governor. Sylves anticipates that the simulations will provide the individualized instruction and almost instantaneous feedback that is important in helping students develop their own reasoning abilities.

In addition to the new lessons being designed for PLATO, the Office of Computer-Based Instruction is making plans for the future. The university will continue offering computer-based education services to schools, industry, and private citizens. Groups can lease or purchase computer terminals and link them to the Delaware system. The staff would like to publish the lessons they are developing and make their materials available nationwide. Another future goal, according to Hofstetter, is the use of microcomputers in life long learning. Working with the Division of Continuing Education he anticipates someday offering courses in people's homes.

The primary goal of the University of Delaware PLATO project continues to be the improvement of instruction. In June 1982 the university will sponsor a national conference on research in computer-based learning. During the conference participants will hear presentations on the state of computer-based learning research and have an opportunity to discuss and plan ways of bringing researchers together. Hofstetter believes the computer-based education program at the university is successful. In listing the benefits of PLATO to the school and the students he includes individualized instruction, reduction in the time needed for instruction, presentation of complex phenomena through graphic visual representation, and access to a wide range of data for checking out hypotheses.

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The University of Texas at Austin
Computers and Elementary Modern Standard Arabic

Students learning Arabic at the University of Texas at Austin use computer-assisted programs in the Arabic writing system and elementary Modern Standard Arabic in conjunction with regular classroom instruction. Victorine Abboud, assistant professor of Education and director of the Computer-Assisted Instruction Laboratory of the Center for Middle Eastern Studies, designed the computer-assisted instruction (CAI) programs to supplement first year Arabic courses.

Recognizing that foreign language instruction, particularly in a non-Western language, is a challenge for both faculty and students, Abboud set out to design an exciting program that would stimulate commitment to undertaking the task. During a regular 50-minute language class with 30 students in attendance, the instructor seldom attains more than five interactions with each student. Abboud characterizes foreign language learning as the establishment of a set of neural and muscular habits that function automatically. To achieve fluency in speech and writing students must receive a high level of reinforcement in order to acquire the habits of the new language.

With her CAI programs Abboud has increased the number of interactions between student and instructor from five to 50 interactions in a 50-minute session. CAI interactions are defined as two-way communications between computer and student. The computer also provides immediate reinforcement which can accommodate differences in learning speed. Abboud's research indicates that a well-conceived computer-assisted program combined with coordinated classroom instruction is more effective for teaching Arabic that either a conventional classroom situation or computer instruction employed alone.

Abboud first offered her CAI course in the Arabic writing system in 1971. The purpose of the course is to teach English-speaking adult students to write correctly both the cursive and printed forms of Arabic, to discriminate sounds, and to read simple materials. The Arabic language consists of 28 characters, is written from right to left, and employs diacritical points and slashes. Twenty-two of the 28 characters change shape depending on their position in a word and can be connected to letters preceding and following them. The remaining six characters do not change shape and can only be connected to the preceeding letter. Abboud divided the coursework into four cycles, each of which presents a different set of seven letters and a variety of diacritical marks. During each cycle students learn to form words and utterances and take tests for self-evaluation and for measurement and grading.

Students begin the program by learning about Arabic connectors and nonconnectors and the differences between cursive and printed forms of Arabic. Arabic letters are displayed on a cathode ray tube (CRT) unit while an audio tape unit relays the sound of the letters. Students use a light pen to register their answer when choosing responses to multiple-choice exercises. During each lesson students are not allowed to advance until they have mastered the material already presented. Students must score 90 percent or better on each cycle's test to be allowed to continue. If the score is at least 80 percent the student is branched to a review of the lesson materials and re-tested. In branching the computer chooses between alternative programs depending upon the conditions existant at the time. When students' scores are below 80 percent they must repeat the entire lesson.

In instructing how to form various Arabic letters and words, the computer displays the characters on the screen with guidelines, arrows, and numbers indicating the letter's position and the direction in which it should be written. The guidelines are gradually withdrawn while students practice writing the characters in their notebooks. By

pressing the keyboard's space bar the letter will disappear from the screen and lines indicating the size of the letter will appear. Using a grease pencil the student can write the letter on the face of the screen. By pressing the space bar once again, the letter will reappear behind the student's letter, and the student can compare the correct character shape with the letter he or she has drawn on the screen.

One advantage of the CAI writing program, according to Abboud, is that the computer can simultaneously handle a large number of students and provide immediate response. In a classroom it would be very difficult for an instructor to correct each character and word that each student practices. Abboud finds that the CAI program reduces the teaching time from 30–36 classroom hours to four to six hours at the computer and three classroom hours for sound drills. During the 1970–71 academic year the CAI program at the university was evaluated against a programmed instruction (PI) course at the University of Michigan and a language laboratory (AL) at Georgetown University. The CAI course took 40 percent less time to complete than the other courses. In writing skills the mean score on the final test for each group was 91.5 for the CAI group, 79.3 for PI Students, and 68.2 for the AL class.

The other CAI Arabic course designed by Abboud, Elementary Modern Standard Arabic, is being offered for the first time during the 1980–81 academic year. The two semester CAI course covers the materials presented in the standard three semester classroom course. The course provides 45 one to one-and-a-half hour lessons in elementary Arabic vocabulary and comprehension. Abboud views the CAI component as expanding and reinforcing the students' retention of vocabulary items and increasing the students' ability to rapidly comprehend passages of written material. For example, in the early lessons complete English translations are given for Arabic materials. In later lessons only the new words are translated. Exercises include fill-in-the-blanks, matching games, sentence generation, and question-and-answer. The testing and branching procedures are similar to those employed in the CAI writing course. In addition, the computer monitors each student's test and exercise performances and keeps track of each student's progress in the unit. It also records the time spent by students on each module. Abboud plans to use this information for a later statistical analysis of the course.

During the 1980–81 academic year 39 undergraduate and graduate students have used the CAI programs in conjunction with first-year Arabic. Abboud notes that while their majors or fields of concentration are varied, they share a common interest in the language and culture of the Arabic world, and many plan careers that will take them to the Middle East.

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Goucher College
Academic Computing

Computer use has become widespread in a number of departments at Goucher since 1977, when the college administration appointed Barton Houseman and Lewis Walker, both professors of chemistry, to be directors of academic computing. Through efforts which Houseman describes as "largely evangelical," he and Walker raised an interest in computing and computer-assisted instruction among their colleagues throughout the college.

"I'm not mathematical enough to handle programming" and "Computers might be useful in science and engineering, but not in the arts or the humanities" represent typical comments Houseman and Walker received when they started talking computers to the Goucher faculty. They instituted a series of week-long workshops in the summer of 1977 to demonstrate just how easy to use and potentially valuable to teaching and research computers might be. Instructors were paid a modest stipend in exchange for their attendance. Houseman and Walker wrote programs in the BASIC computer language, which requires little mathematical expertise, in the disciplines represented by each of the original participants.

Workshop participants came away surprised. Nearly half the faculty has begun to use computers in some capacity in the past four years, and Houseman estimates that 60 percent of the student body has studied using faculty-created programs. The administration predicts that by 1982, virtually all Goucher students and perhaps 80 percent of the faculty will have spent some time at a computer terminal.

To assist instructors in incorporating CAI into their courses, Houseman and Walker designed a system called TUTOR which allows instructors to write tests in a number of formats and styles which can then be keyed into the computer. The staff of the school's Computer Center does most of the programming, although some faculty members feel confident enough after the workshop to do it themselves. Nine different types of questions are available. Five of these formats represent different styles of multiple choice questions; two are true/false; two are matching drills. With TUTOR, instructors can choose the test format that best suits their subject matter and develop programs accordingly. All programming is done in BASIC.

To date, computer programs have been created for courses in English, fine arts, political science, biology, chemistry, and first aid. A sophomore required course called Arts and Ideas, which is a general survey of cultural history, uses separate programs to review each unit of the text, as does an introductory political science course. An English course called Words, Words, Words relies on computer drills to help students identify Greek and Latin root words, prefixes, and suffixes. A few mid- and upper-level science courses require the assistance of computers to introduce laboratory procedures; a module has been designed to illustrate techniques of cardiopulmonary resuscitation.

Houseman states that, although computers make excellent study aids, they will never become instructors in their own right. CAI, he says, is most beneficial to students late in the learning process, helping them to review material they have already learned. According to Houseman, study with the aid of the computer has caused many students'

test scores to improve. Surveys of student opinion indicate that they feel computer use is as academically valuable as it is fun.

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Rensselaer Polytechnic Institute

Computer-Assisted Sociology Course

Recognizing that many Rensselaer Polytechnic Institute (RPI) students were disinterested in a course such as introductory sociology, the chairperson of the department of anthropology and sociology designed a class which builds upon their interest and skills in computing. Approximately 90 percent of the RPI undergraduates earn degrees from the schools of engineering or science. While all students are required to take four courses each in humanities and social sciences, only 120 students out of approximately 4,000 undergraduates enroll in sociology each semester.

David Ellison, chairperson and associate professor of sociology, designed a computer-oriented section of introductory sociology with two principles in mind: 1) RPI engineering students need social science to make them more aware as human beings and more effective as engineers and 2) the department of sociology and anthropology needs a course that will build upon students' existing skills and enhance their interest in sociology.

Four sections of the introductory course are usually taught each semester. The standard course focuses on helping each student understand his or her social situation and the influences that social situation had on his or her thinking, perspective, and behavior. The students are asked to think about the social groups they belong to and about how they were socialized. Employing lectures, class discussions, text books, and supplementary readings, the class covers such topics as the role behavior of men and women, institutions and their influences, the family, and the effects of technology.

Using the traditional course's focus on sociological concepts, Ellison expanded the computer-oriented section with written exercises that allowed students to work with data from the National Opinion Research Center's General Social Survey (GSS), which had been entered into RPI's computer system. The National Opinion Research Center is associated with the University of Chicago. Since 1960 the center has interviewed a representative sample of the American population almost every year to determine their views on various current topics. RPI is using the 1972-80 survey which questioned 1,500 people throughout the country on such subjects as gun control, political preferences, euthanasia, abortion, and book banning. In addition, the respondants provide personal data such as their age, marital status, religious preference, and income.

With funds from a National Science Foundation Local Course Improvement (LOCI) grant, Ellison developed exercises which require the students to develop their own operational measures and tabulate the correlates. The assignments help the students learn to use sociological concepts and think from a sociological perspective. They are able to trace the changes in opinion from year to year. For example, the undergraduates might explore how opinions on the ideal number of children have changed from 1972 to 1980. They could see how a respondant's age, religion, or sex affect the opinions. Students also use the center's Code Book. This document provides a summary of the number of like responses for each question asked in the survey.

In the first exercise students are asked to give their own opinion on a topic, estimate the frequency distribution of that response for the American population, and compare their answers with the actual distribution. When their responses differ from that of the general population students are forced to ask "what is there in my socio-cultural background that leads to my particular biases?" Once students are familiar with the GSS variables they are able to complete the remaining exercises. Other assignments allow students to explore such topics as sex roles, social groups, organizations and bureaucracy, the family, and population and health. In the religion exercise, for example, students review the relationships between religion and attitudes toward abortion, euthanasia, or suicide.

Ellison discovered that students choose exercise topics which are relevant to their own social situations. For example, a student from a rural farm background compared the opinions of large city professionals to those of small town service workers and farmers. She was surprised to find that the two groups did not differ on percent married, religious attendance, or political convictions. Another undergraduate, from a large Catholic family, compared the views of Catholic families with few (0-2), some (3-5), and many (6-8) children. She found that small Catholic families were happier than the general population, while the two larger groups were not as happy.

The computer-oriented course, according to Ellison, does not allow students to think in a vacuum. The students are able to see what the rest of the country thinks about a particular issue and to discover that their opinions are not unanimously held. Ellison believes it is important for future engineers to have some understanding of the human and social dimensions of decision-making and problem-solving. By "turning students on to sociology with computers," he hopes to interest them in other social science and humanities courses.

Ellison says that "anyone who can follow a cookbook with good results, can use the computer to complete the exercises." In fact, 95 percent of the RPI students have basic computing skills at graduation. Most of the students in Ellison's class know how to use the computer in quantitative calculations, but they do not have experience with social data. Ellison believes that "by linking student computer skills and social survey data in a sociology course of this nature we expect the student to have more facts about the society, greater interest in social issues, and more understanding of theory and method in sociology."

The computer-oriented section was first offered in fall 1980. Normally 50 percent of the introductory sociology class are freshmen. Because Ellison stressed the necessity of computer skills for the course, only 11 percent of the students were first year. At the end of the semester Ellison asked the class members to complete course evaluation forms. Students commented that the computer assignments proved to be helpful and motivating. They reacted

positively to the course but felt that there were too many assignments and too much work for a basic course. Based on the students' comments, Ellison has modified the computer-oriented section to make it more appropriate at the introductory level. The section is being offered during spring 1981, and Ellison anticipates that it will be continued as an option.

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University of Minnesota

Computer-Assisted Instruction in Technical Terminology

Most of the technical vocabularies used in medicine, law, and business trace their etymologies to the languages of ancient Greece and Rome. To assist students in communicating confidently in these fields, the classics department at the University of Minnesota's Twin Cities campus has developed six computer-based courses to teach word construction from Latin and Greek root words, prefixes, and suffixes.

The first technical terminologies course introduced to the curriculum, Classics 1/1045, Basic Vocabulary Development, was pilot-tested in spring 1977. According to Gerald Erickson, professor of classics and the project's principal investigator, the course consists of 51 computer-assisted instruction (CAI) modules and one classroom session to introduce the workings of the terminal. Exercises employ a variety of formats. Students may expect to provide English definitions for hypothetical words built from Latin or Greek morphemes or match lists of Latin and Greek words with their English synonyms and antonyms. The course requires between 30 and 40 hours of student-computer interaction, which is generally accomplished over three academic quarters.

Classics 1/1045 was evaluated after the first group of students had completed all the CAI modules. Students took vocabulary tests at the beginning and at the end of the course; those who scored below the 90th perentile on the pretest showed significant improvement on the post-test. According to Erickson, most students who have finished the course to date have achieved A or B averages; the lack of grade distribution in the C to failing range, he says, indicates that the course is successful in imparting to students a mastery of the language.

Of the five advanced technical terminologies courses projected by the classics department in 1977, four are currently offered with Classics 1/1045 as prerequisite. Two of the courses — Technical Terms for the Medical and Biological Sciences and Technical Terms for Nursing and the Paramedical Professions — deal extensively with the vocabulary associated with human anatomy and body systems. The nursing course contains 135 CAI units as compared to the medical course's 70 units and uses the type of reports nurses, technicians, and medical secretaries might expect to encounter on the job. Two additional courses, Advanced Etymology (intended for preprofessionals outside of medicine) and Advanced Medical Terminology, delve into the Indo-European origins of the Latin, Greek, Germanic, Slavic, and Sanskrit language groups and make connections among modern languages and their ancient predecessors. Both Advanced Etymology and Advanced Medical Terminology include significant background material on aspects of ancient Greek and Roman culture. A fifth technical terminologies course intended for agriculture majors is in preparation.

According to Erickson, the classics department received valuable cooperation from members of the pre-medical, pre-law, and nursing faculties in preparing material for Technical Terminologies courses. A few of the programs were in fact written by instructors in the appropriate departments. Further assistance was provided by graphics experts, cognitive psychologists, the university computer center staff, and the campus-based Consulting Group on Instructional Design. The result, says Erickson, are courses that provide both cultural enrichment and essential professional skills.

Besides Technical Terminologies courses, the classics department has developed computer-assisted units for courses required of its majors. Students in all classical literature courses must complete CAI units designed to introduce 63 essential Latin figures of speech; CAI units accompany basic courses in classical and Biblical Greek. An introductory Latin course that relies heavily on CAI is being pilot-tested to a group of 10 students this quarter; CAI classics courses in the works include introductory Greek and Latin poetry and modules simulating archaeological techniques.

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Metropolitan State University

Computer-Based Education

Since its establishment in 1971 as an experimental university, Metropolitan State University (Metro U) has offered adults an alternative approach to earning the Bachelor of Arts degree. Included in the goals of this upper division institution is the commitment to testing a variety of instructional approaches and delivery systems to enhance the university's effectiveness. Computer-based education (CBE), according to Fancher Wolfe, Academic Computer Director, is one type of cost-effective nontraditional delivery system that is provided as an option for Metro U students.

The undergraduates design their own educational plans based on individual goals, interests, and learning needs. In designing their degree plans, students employ the learning strategies and tools which work best for them. For some students these strategies include regularly scheduled classes, faculty or student designed independent study

units, and internships. Other students opt for courses or competencies provided with computer-assisted instruction (CAI). These students are aided by Metro U's membership in the Minnesota Educational Computing Consortium, which provides more than 300 university-level computing programs, and by Metro U's development of a Center for Computer-based Instructional Development and Training.

The center was established following a 1979 grant, funded by Control Data Corporation, for developing and using new technologies in delivering educational services. The university assessed the use of PLATO learning units and concluded that the units could be used as supplemental materials for existing Metro U courses or independent study lessons, in combination as PLATO-delivered independent study, as assessments of experiential learning, and for remedial instruction. Metro U courses which use PLATO include Small Business Managment Independent Study, Research Methodology in the Human Services Independent Study, and Systems and Techniques of Vocabulary Development. The vocabulary course for example, employs the PLATO lessons Word Power These consist of 25 English vocabulary lessons and four tests that take a total of 40 hours to complete. Approximately 30 students per year use the vocabulary exercises.

The center disseminates information on the Metro U PLATO project and tries to focus attention on the principles and techniques of computer-based instruction. The center's activities include a two-course sequence in computer-managed instruction (CMI), training workshops in CMI, and a national conference on CBE. The CMI instructional courses are Curriculum Design of Computer-Managed Instruction and Curriculum Development of Computer-Managed Instruction. Taught by the center's instructional design specialist, the courses focus on assisting students, faculty, and other professionals in learning the principles of individualized instruction and its application on PLATO. In CMI, according to Wolfe, the computer is used as a diagnostical tool. The computer tests the students' abilities and then refers them to the appropriate resource to learn more about the subject. Instructors can organize the resource material using the management of the computer.

In the design course students evaluate various forms and styles of instruction and learn about the roles of computers in instruction. Topics include the future of education, design/development concepts, and the basics of CMI. Students also must complete the PLATO lesson CREATE, which focuses on curriculum design. In the second course students develop and design a computer-managed course in a subject of their choice. Twenty-seven students enrolled in the courses during 1980. Units developed by the students include Overview of Reading, Nursing Curriculum, Successful Bulk Petroleum Sales, and Electric Snow Melting Design and Installation. Overview of Reading, for example, was designed by an assistant professor at St. Olaf College and is intended for college students in education, child development, or psychology. The unit takes ten minutes to complete and covers theories of how children learn to read and approaches used to study this learning process. The petroleum sales course was developed by a technical training supervisor at a local company and provides salespersons with information on developing a "pin point your sales" map and maintaining monthly profit and loss statements.

The two-course sequence, according to Wolfe, is taught machine free. Wolfe believes that the strongest CBE program must first be carefully thought through and written out on paper before it goes on the computer. Using the students' detailed lesson plans a clerk can put the program on the computer. Wolfe anticipates that the courses will be offered again in the fall.

Another activity of the center is the sponsorship of CBE workshops. During 1980, eight workshops attracted 126 participants including Metro U faculty and employees from local businesses and industries. Faculty and computer specialists presented programs on such topics as "Tools and Techniques of Curriculum Design" and "The Role of Computers in the Schools of the Future." In addition, Metro U and Control Data Corporation co-sponsored a national conference on computer-based education in October 1980. The conference theme was "Changing How We Learn: The Future of Computer-Based Education and Training." Conference focuses included approaches to design and development of computer-based courses, interaction of computer-based courses and different adult learning styles, and computers in business training courses.

The center's assistance in the development of CBE is another step in Metro U's commitment to flexible study programs for adults. Although students are not required to complete any computer literacy materials, they are encouraged to enroll in courses which complement their program of study. For example, business students might take Managerial Aspects of Computer Processing. To help acquaint students with computer terminals and computer delivered education, faculty have created drill and practice units for Future Studies and Library Usage courses. Future Studies: An Overview is designed to introduce students to the academic discipline of future studies through discussions of social, economic, environmental, technological, and political trends. Berenice Bleedorn, Metro U community faculty member and Director of the Center for Creative Studies at the College of St. Thomas, designed the course six years ago and tries to help students speculate about the future and realize that they can change and create their own futures. Recognizing that she was "denying what the future was all about" by not including a CAI component in the course, Bleedorn developed a vocabulary drill and test as a simple method for introducing CAI. She chose a vocabulary drill because most students are unfamiliar with future studies terminology. The required computer unit includes a collection of terms and definitions arranged in a drill-by-choice pattern. The required CAI segment was offered for the first time to 17 students during the fall 1980 semester. Bleedorn notes that the average age of Metro U students is 34 and that many of the students in her class were re-entry women. The students expressed initial fear and frustration of CAI but later praised the experience and were grateful for having been required to "face up to the new experience." Having designed the program without a technological background, Bleedorn offers these words of advice for others interested in integrating CAI into their courses: "The instructor, however totally unrehearsed in computer technology, needs to persuade himself or herself first that an antipathy towards CAI is an inappropriate limitation of options for teaching and learning in our age. Secondly, it is possible, with help, to take the plunge and enjoy the sensation of excitement that goes with experimentation and discovery."

Fancher Wolfe says that one advantage of CAI is that a wider number of courses can be offered. For example, an

anthropology professor could manage students' computer courses in anthropology even if the topics were outside the area of his or her specialization. He lists other advantages of CAI as its availability, its characteristic of being less threatening than a professor to some students, and its ability to teach mastery since students cannot "skip over" material that they do not understand.

For more information, contact:
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Beaver College

Computer-Assisted Instruction in Statistics

Psychology instructors at Beaver College have used personalized self-instruction (PSI) to augment a course in basic statistical research methods since the early 1970s. Students using PSI attended lectures and read through a text which introduced statistical concepts and completed a series of exercises in a workbook designed by the department staff. Using funds from the National Science Foundation and the assistance of the college's computer center staff, the psychology faculty has developed a system by which workbook exercises have been replaced by units of computer-assisted instruction.

Computer-assisted instruction (CAI) statistics was first offered at Beaver in the fall of 1980. Each of the course's 16 instructional units has a set of computer-based exercises designed to increase students' knowledge of statistics by leading through the steps involved in solving particular problems. Richard Evans, an assistant professor of psychology who has taught introductory statistics for the past two years, explains this method of instruction as conducive to students' retention of statistical knowledge after the end of the course. Evans's theories are supported by recent research in cognitive psychology that suggests that individuals learn best and retain more when abstract concepts are presented through relevant problems to be solved within a specific, logical framework. In this case, CAI exercises function as the context for problem-solving; the statistical methods employed by student and computer represent the knowledge which will be retained.

For example, the course's first unit introduces students to the concept of the *mean* as a method of analyzing raw data. In the first exercise, the computer screen displays a list of words and gives students a short amount of time to memorize it. After the list disappears from the screen, students type into the terminal as many words as they remember. The exercise is conducted five times in all. In the process, students should come to realize that giving themselves a mean rating of 6.8 words correct is more relevant to the exercise at hand than recording a total score of 34 correct answers out of a possible 50.

CAI statistics has a number of advantages over non-computerized PSI. At the end of each unit, students take tests to measure their progress through the unit. The tests have no bearing on students' grades, although the results demonstrate to both student and instructor areas in which extra attention might be needed. If a student fails a test, he or she takes the hard copy the computer generates to a tutor and the two work out any problems the student might have. This arrangement frees tutors from basic instructional duties and allows them time to work out conceptual issues with students who experience difficulties. Equally important, the course familiarizes future doctors and researchers with the workings of the computer, perhaps the most basic tool of statistical research.

Although no formal evaluation can be conducted until the first group of students completes the course this spring, several conclusions have been drawn. First, although students' pace through the units has neither significantly speeded up or slowed down, test scores prove that more students come away from the computer with an adequate understanding of statistics than they did when using only a workbook. The exams given this year have been tougher than in previous years, requiring more broad conceptual knowledge, and, according to Evans, approximately two thirds of his students have performed well. The one major drawback of CAI, says Evans, is its lack of a diagnostic element. The computer cannot yet tell when a student beginning the course has adequate preparation in mathematics or needs remedial assistance before starting the exercises. The department is now working towards further developing the system so that the exercises will be tailored more towards individual students' needs.

Bernard Mausner, chairperson of the psychology department, emphasizes that CAI will never replace classroom instruction or reading. The computer, he says, makes an excellent tutor, but relies heavily on human instruction and critical evaluation of textual material. CAI statistics has ties to all three of the psychology department's year long core courses required of psychology majors; in particular the sophomore course, which students generally take at the same time they take basic statistics, makes extensive use of students' developing statistical abilities.

For more information, contact:

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Additional Programs

Brandeis University, Waltham, MA 02154

Intermediate Macroeconomics—Economics majors at Brandeis University are required to take an intermediate macroeconomics course that employs macroeconomic policy simulation games played with a computer. The gaming element of the course was developed more than 10 years ago when the developers realized that conventional textbook instruction was not always the best method for teaching economics. The developers, including F. Trenery Dolbear, Jr., professor of economics, wanted their students to "actively participate in the learning process, receive continuous feedback, and have the opportunity to repeatedly apply new ideas in a variety of contexts." The basic macroeconomics game used in the course simulates the economy of a mythical country and requires students to become economic policy-makers for the country. The game relates to the first several lectures and reading assignments in the class and takes between one and two hours to complete. By instructing the computer to alter policy variables, such as taxes or government spending, students can track the results of their policy-making over a period of 18 years. Any policy mistakes that they have made early in the game are reflected in the options available during the latter part of the 18 year period. Dolbear finds that students enjoy the course and report a beneficial effect on their understanding of course materials. Dolbear has designed a more difficult simulation game which is used when he teaches the course himself. Students are given 32 variables to work with as policy-makers. The undergraduates meet in groups to discuss the assignments which take approximately three to four weeks to complete. The more advanced game requires students to bring together materials studied during the entire course. At the end of the game a make-believe press conference is held with faculty members as reporters. Students are questioned in their roles as economic advisers and are forced to think about and react to what they have learned. Dolbear believes that one of the most important attitudes that an instructor can bring to computer-assisted instruction is enthusiasm. He has discovered that student reaction is in direct proportion to the instructor's enthusiasm. "For example," Dolbear says, "if an instructor passes out an assignment, tells students to go to the computer center, and then never mentions it again, those students will be likely to report that the assignment was a waste of time."

F. Trenery Dolbear, Jr., Professor of Economics

College of Charleston, Charleston, SC 29401

Computer-Assisted Instruction in Calculus and Linear Algebra—The College of Charleston's math department currently uses computer-assisted instruction in its linear algebra course and the first semester of a three-semester introductory calculus course. Three modes of exercises have been programmed into the system. The first, an optional self-testing mode, enables students to evaluate their problem-solving capabilities through their performance on computer-administered quizzes. The computer will always tell students using this mode whether or not they have solved a problem correctly and will sometimes give hints if students wish. The other two exercise modes, drill-and-practice and tutorial, complement each other in practice. Should students err on a particular drill problem, the computer will concentrate on that type of problem throughout the exercise's duration. If a number of errors occur, the computer will recommend that students take the printout to their instructor for individual consultation. At present, computer interaction is not required of basic math students, although out of the approximately 800 students who have taken calculus or linear algebra since the system was inaugurated in 1979, more than 60 percent have used the computer at least twice.

Brian Wesselink, Associate Professor, Department of Mathematics

Lehigh University, Bethlehem, PA 18015

Graduate Studies in Educational Technology—Lehigh's school of education, with the assistance of the university's computer science department, has developed a new graduate program aimed at complementing advanced educational theory with an understanding of computer-based instructional systems. The goals of the program are fivefold: to impart a technical understanding of programming; to provide basic knowledge of microcomputer hardware and software; to expose students to broad theories of educational research; to allow students to apply computer-assisted instruction (CAI) within the framework of a specific discipline; and to provide classroom experience. Inaugurated in the summer of 1980, the program operates out of a 25-terminal microcomputer center. Core courses include nine hours of programming instruction in BASIC and PASCAL, six hours of educational methods instruction, and three hours each of computer technology and instructional computing courses. In addition, three hours of directed field experience and six hours of electives from such fields as special education, curriculum construction, and developmental reading are required for completion of the degree. Previous exposure to computers, although helpful, is not prerequisite for admission to the program; the school of education welcomes applications from students holding undergraduate degrees in education and liberal arts. Enrollment is restricted, however, to 25 students per year.

Leroy J. Tuscher, Coordinator, Graduate Studies in Educational Technology

Macalester College, St. Paul, MN 55105

Computer-Assisted Instruction in Geology—For some years now, instructors in Macalester's geology department have encouraged their students to prepare for exams by studying copies of previous years' tests and quizzes filed in the departmental office. As study aids, the documents proved invaluable; however, since most introductory courses enroll between 30 and 40 students, lines of students wishing to use the files grew quite long towards the end of the term. To alleviate this situation, the department chairperson launched a project in 1977 under which all the back tests were programmed into the school's PDP 11 computer system. This system links 38 terminals located in various parts of campus, including the library and several departmental offices. Initially, the programs were presented as consecutive units arranged according to the order in which the instructor presented them in class. Students could proceed to the unit of their choice only after completing sample tests from all preceding units. With the aid of a National Science Foundation Comprehensive Assistance to Undergraduate Science Education (CAUSE) grant, the system was redesigned last year to enable students to select particular units from an index and answer as many sample questions from that unit as they feel necessary. Unit topics include Minerals, Rocks, Weathering and Soils, Plate Tectonics, and other broad areas covered by the department's three basic courses, Physical Geology, Oceanography, and Mineralogy. Each unit contains approximately 70 study questions, both multiple choice and short answer. The computer informs students as to whether or not their answers are correct, and if incorrect, allows them the opportunity to try again until they answer successfully. The new system was inaugurated in January 1981; no data on its effectiveness is expected until the end of the spring semester. An informal survey was conducted by the chairperson recently: out of a class of 16 students, 12 responded that they had used the computer's assistance for every unit covered by the instructor, and 11 of them labled that assistance as "very useful."

Henry Lepp, Professor and Chairperson, Department of Geology

Merritt College, Oakland, CA 94169

Computer-Assisted Instruction in the Biosciences—Merritt College, part of the Peralta Community College District, offers computer-assisted instruction in general biology, anatomy, physiology, and microbiology courses. The program in microbiology, in operation since 1975, is the most well-defined and extensively used of the four. Instructor James Mohr has compiled lists of between 40 and 60 words relevant to each of the seven units of the standard text used in his introductory course; students define the words through their reading and take sample tests on the computer until they feel comfortable enough with the list to take graded vocabulary exercises. All students must take computer-based vocabulary quizzes. According to Mohr, students who have practiced for the test by taking repeated computer-assisted practice quizzes perform better on the graded exercises than students who run through the list once or do not use the computer at all to study. As an additional study aid, the computer supplies background information that helps students understand the basic concepts of microbiology. In general biology courses, the computer assists students in grasping the fundamentals of genetics by simulating cross-breeding. In graded exercises, which students may also practice as often as they wish, the computer supplies a set of hypothetical parents and students try to determine specific traits that should appear in their offspring. Both anatomy and physiology courses have limited computer-assisted vocabulary exercises. Mohr says that students are not expected to absorb much knowledge of how the computer works, although he attempts to explain methods of programming to the many students who express interest in the subject.

James Mohr, Instructor, Department of Biosciences

Millikin University, Decatur, IL 62522

Computer-Training for Students in the Behavioral Sciences—Computer technology's expanding applications to the behavioral sciences

have prompted members of Millikin's psychology and sociology faculties to incorporate data processing training modules into undergraduate courses in those disciplines. One semester of a two-semester required experimental psychology course now devotes one lab period every two weeks to the use of the computer in interpreting statistics; instruction begins at the most basic level of introduction to hardware, software, and technical jargon and proceeds through the use and application of standardized Statistical Packages for the Social Sciences (SPSS) and Statistical Analysis Systems (SAS). These two systems offer a wide variety of programs which are easily understandable for anyone with a background in social science terminology; they are used by field researchers as substitutes for more complex languages such as BASIC and FORTRAN. The National Opinion Research Center's General Social Survey (GSS), a survey of 500 variables in approximately 10,000 randomly selected subjects, is used as a data base for experiments in sociology courses at all levels. Both students and faculty responded to the use of computers with trepidation, although during the three years since the system was introduced, most have come to realize the invaluable role data processing plays in behavioral science research. All programs currently in use have been written elsewhere and purchased by the department, although by next fall some faculty-created programs will be introduced. Between 25 and 30 students each semester use the department's APPLE II microcomputer in experimental psychology; approximately 125 students in introductory and advanced sociology courses use the GSS, which is stored on the university's VAX 11/780 computer.

David Rowland, Assistant Professor of Psychology
Larry Crisler, Assistant Professor of Sociology

University of Nebraska-Lincoln, Lincoln, NE 68588

PLATO-Assisted Instruction in Political Science and Sociology—The University of Nebraska's political science and sociology department has recently incorporated computer-assisted instruction into its existing introductory policy evaluation and research methods courses. The program uses the PLATO system developed at the University of Illinois to introduce such basic statistical concepts as means, modes, and standard deviations to the courses' regular lecture-discussion format. Students enrolled in the courses are required to spend two to three hours on the computer during the semester, although those who have little or no experience with mathematics or research methods are encouraged to spend extra computer time preparing for the statistical material. In addition to these courses, the department staff implemented a computer-based mini-course this semester in which students play certain roles within simulated scenarios. Four different scenarios have been created. In the first, students play the role of a President of the United States faced with a specific foreign policy crisis; the second requires that students act as campaign manager for a congressional candidate and plot appropriate strategy for winning the election. In the third and fourth scenarios, students play the roles of a chairperson of a Senate committee and the leader of a public service workers' union, respectively. Approximately 100 students are using PLATO this semester to augment their political science and sociology courses. While no formal evaluations have been conducted yet, students' comments indicate that they like working with the computers and find them helpful for clarifying intricate political issues. Faculty support of the project has been strong; many instructors in political science and sociology as well as other departments of the university have expressed a desire to incorporate such instructional methods into their own courses. A spokesperson for the political science and sociology department states that the current staff activities center on expanding existing facilities and developing CAI modules for other courses the department now offers.

Susan Welch, Department of Political Science and Sociology

Ohio State University, Columbus, OH 43210

Landscape Architecture Computer Heuristics—To free instructors' time for discussion of conceptual issues, Ohio State's landscape architecture department and Instructional Materials Production Center have developed a set of computer-based exercises to help students understand fundamental problems of landscape layout and measurement. Landscape Architecture Computer Heuristics (LARCH) operates in conjunction with the department's required junior-level course, Landscape Construction: Site Systems, which consists of academic units on land forms, surveying techniques, road alignment, and drainage. A CAI unit corresponds with each of these topics; each unit contains four or five modules of closely related problems. The computer provides data pertaining to a particular landscape and students apply the techniques they learn in class to arrive at the best possible solution. To insure that students' errors are properly diagnosed and addressed, the computer is programmed internally with wrong answers, enabling it to analyze students' responses step-by-step and find any problems and suggest alternatives. Students may repeat exercises as often as they wish; all students, however, are required to complete graded exercises on each unit, the results of which count as approximately one-fifth of the final grade. On both practice lessons and quizzes, the computer generates a new set of data for each problem.

William Heck, Systems Analyst, Instructional Material Production Center

University of Wisconsin-Parkside, Kenosha, WI 53141

Computer-Assisted Instruction in Experimental Biology—Because the costs of chemicals and equipment used in certain biological experiments are prohibitively high, instructors at the University of Wisconsin's Parkside campus are developing computer-based simulations of the laboratory procedures those experiments involve. The first one offered, as part of the junior-level course Modern Techniques in Experimental Biology, requires that students determine the composition of both short and long sequences of DNA. All the options that a laboratory offers are provided by the computer. Students may heat portions of the segment, or add enzymes; experiments may be aborted at any time and started over. An additional option allows students to analyze DNA sequences with compositions of their own determination; according to a program spokesperson, analyzing a known sequence familiarizes students with the processes involved in biochemical experimentation. The program itself, which is designed for an APPLE II microcomputer, features sound reproduction and graphics. After the "experiment" is concluded to students' satisfaction, they must write lab reports for submission to their instructor. Both lab reports and computer exercises are graded. Surveys conducted on the CAI simulation units indicate that students progress more quickly through the material than they would without CAI and understand more of the material than they would through lecture and reading. Further computer-simulated experiments with enzyme kinetics and neural action potentials are currently being developed.

Michael Marrin, Professor, Department of Chemistry

Resources

Association for the Development of Computer-Based Instructional Systems (ADCIS), c/o Gordon Hayes, Executive Secretary, ADCIS, Computer Center, Western Washington University, Bellingham, WA 98225. (206) 676-2860.

ADCIS is an international non-profit organization of individuals and institutions interested in advancing the investigation and utilization of computer-based instructional systems. Members represent business, industry, the military, and government agencies as well as all types of elementary, secondary, and postsecondary schools. The organization publishes a bimonthly newsletter and the quarterly *Journal of Computer-Based Instruction*. ADCIS also sponsors a number of special interest groups, ranging from PLATO and minicomputer users' groups to national consortia on the uses of computer technology to teach such subjects as mathematics, music, and home economics.

Association for Educational Data Systems (AEDS), 1201 16th St., N.W., Washington, D.C. 20036. (202) 833-4100.

AEDS provides a forum for the exchange of ideas and information about the relationship of modern technology to modern education. The association sponsors an annual conference for educators and technical specialists. The 1982 conference, "Computers in the World of Education," will be held May 10-14, 1982 in Orlando, Florida. Institutional, individual, and student memberships are available. Members receive three of the AEDS quarterly publications: *AEDS Bulletin*, *AEDS Journal*, and the *AEDS Monitor*. The *AEDS Journal*, for example, presents information on the latest educational applications of computer technology.

Chambers, Jack A., and Sprecher, Jerry W. "Computer-Assisted Instruction: Current Trends and Critical Issues." *Communications of the ACM* 23: 332-341.

In their introduction, Chambers and Sprecher outline the advantages and disadvantages of CAI as it currently exists. On the positive side: students receive instruction they need at a rate which is comfortable for them; real-life situations too costly or dangerous without the computer are easily simulated; and faculty members are permitted more free time to the "more personal, human considerations of their students." On the other hand: instructors employing CAI methods must receive extensive training in computer languages and methods; CAI methods have not been developed to their full potential and are therefore often unsatisfactory; and the cost of necessary equipment is frequently prohibitive. The body of the article is devoted to current activities and theories of CAI specialists in the United States and Great Britain, with brief mention towards the end of efforts in that direction occurring in Canada and Japan.

CONDUIT, P.O. Box 388, Iowa City, IA 52244

CONDUIT (short for *C*omputers at *O*regon State, *N*orth Carolina Educational Computing Service, *D*artmouth College, and the *U*niversities of *I*owa and *T*exas at Austin), located at the University of Iowa, is a national clearinghouse for computer-based instructional materials. CONDUIT designs, develops, evaluates, packages, and disseminates computer-assisted instructional packets for high schools, community and four-year colleges, businesses, and individuals. The CONDUIT staff is composed of computer professionals from the University of Iowa; the board of directors, elected by CONDUIT members, assists the organization in promoting their efforts nationwide. Three types of affiliation are available to interested persons. *Members*, who participate in program reviews and evaluations, are primarily schools or institutions with an ongoing interest in computing. They pay an annual fee, and select a coordinator and a programmer as CONDUIT liaisons. *Subscribers*, both individual and institutional, receive announcements and descriptions of new CONDUIT materials as well as the organization's semi-annual magazine, *Pipeline* but do not participate in the decision-making process. Members of particular *discipline groups* receive briefings on new CONDUIT packets directed towards their specific area of endeavor. For information on membership rates and services, write to the CONDUIT director at the above address.

Dean, Peter M. "Why CBI? An Examination of the Case for Computer-Based Instruction." *Journal of Computer-Based Instruction* 4: 1-7.

First presented on February 21, 1977 at the Annual Conference of the Association for the Development of Computer-Based Instructional Systems in Wilmington, Delaware, Dean's article highlights the fact that students are apt to learn and retain more when some external discipline is applied. While supervision by instructors and peer tutors is in many ways effective, Dean argues that assistance from a computer is desirable, as machines neither falsely encourage students who answer questions correctly during drill and practice sessions, nor do they unnecessarily discourage students who might need a little extra patience. Dean recommends that instructors develop computer programs that divide their coursework into small units to encourage frequent, informal test sessions and constant student progress.

Human Resources Research Organization. *Academic Computing Directory. A Search for Exemplary Institutions Using Computers for Learning and Teaching*. Alexandria, VA: Human Resources Research Organization, 1977.

With funds from the National Science Foundation, the Human Resources Research Organization (HumRRO) gathered information on 94 elementary and secondary schools, 71 public school districts, 37 community colleges, 158 private and public colleges and universities, and 7 public access learning institutions that successfully use computers for learning and teaching. Each entry contains information on the reasons for that institution's inclusion in the directory, the institution's enrollment, applications of the computer, type of computer, and contact persons. A typical entry might include such information as "Illustrative Applications: On-line testing in mathematics, physics, and anthropology. Graphic tutorials in physics. Sophisticated game management in ecology." To order the directory contact the Publications Distribution Coordinator, HumRRO, 300 N. Washington St., Alexandria, VA 22314. (703) 549-3611.

Journal of Computer-Based Instruction

Published quarterly by the Association for the Development of Computer-Based Instructional Systems (ADCIS) (see above), the *Journal of Computer-Based Instruction* contains scholarly papers and original investigations of the applications of computer technology to educational systems. The Journal is distributed free of charge to ADCIS members; for nonmembers, annual subscription rates are $12 for individuals and $20 for institutions. Subscription inquiries may be addressed to ADCIS, c/o Computer Center, Western Washington University, Bellingham, WA 98225; unpublished manuscripts may be sent to Keith A. Hall, Editor, Journal of Computer-Based Instruction, The Ohio State University, 121 Ramseyer Hall, 29 W. Woodruff Avenue, Columbus, OH 43210, for consideration.

Kearsley, Greg P. "Some Conceptual Issues in Computer-Assisted Instruction." *Journal of Computer-Based Instruction* 4: 8-10.

Kearsley argues that the principle goal of CAI — namely the administration of truly personalized instruction — has not yet been realized. Most existing CAI systems are "response-insensitive," in that they fail to consider students' varying educational, cultural, and social backgrounds when measuring their accomplishments. He contrasts the relative merits of individualized learning with such valuable features of traditional classroom instruction as motivation and socialization. In conclusion, he states that CAI, while indeed a promising new tool for educators, needs to be further refined to insure students' healthy interaction in the professional world.

Marshall, Sister Patricia. *Instructional Computing in Minority Institutions. A Needs/Strategy Assessment*. New Orleans, LA: Educational Computing in Minority Institutions, 1979.

This report summarizes the results of a National Science Foundation study that surveyed 239 minority colleges and universities about their instructional computing needs. Marshall found that minority institutions had acquired computer hardware later than most schools. She also found that schools with large numbers of science faculty were more likely to have made efforts to improve their academic computing. One reason that many minority institutions may have less computing activity is that fewer minority staff members have training in computer science. Objectives for developing instructional computing at minority institutions include establishing institutional computing goals and departmental objectives, improving the computer literacy of all students, and enhancing computer service. Also included in the report are essays by Alfred Luerhmann ("Computer Educational Goals at Minority Institutions of Higher Education") and Judith B. Edwards ("Strategies for Improvement of Educational Computing in Minority Institutions"). For information on the report write to Sister Patricia Marshall, College of Pharmacy, Xavier University of Louisiana, 7325 Palmetto Street, New Orleans, LA 70125.

Milner, Stuart, and Wildberger, A.M. "How Should Computers Be Used in Learning?" *Journal of Computer-Based Instruction* 1: 7-12.

Milner and Wildberger present three reasons why computers should be used in education. First, some learning situations require support from computers that no other instructional method can provide, for example simulation of such potentially hazardous processes as surgery or air-traffic controlling. Second, computers provide a wide range of educational benefits from basic drill-and-practice exercises to student-designed automation that no other method can match. Finally, some instances exist in which CAI represents the most economic approach to educational supervision. The article includes a continuum which illustrates the various levels of computer involvement in the learning process, with comments describing the benefits associated with each.

Minority Institutions Science Computer-Assisted Instruction Clearinghouse (MISCAICH), c/o Jack Morrell, Editor, *Comp. Ex.*, Division of Natural Science and Mathematics, Atlanta Junior College, 1630 Stewart Ave., S.W., Atlanta, GA 30310. (404) 656-6366.

The purposes of Project MISCAICH, funded by the National Science Foundation, are to increase awareness of the availability of computer programs that assist student learning and to facilitate exchange of these programs among minority institutions. MISCAICH publishes *Comp. Ex.—The Computing Exchange*, a newsletter containing articles on experiences with computer-assisted instruction (CAI), advantages and disadvantages of different types of CAI, and topics of general interest. The MISCAICH staff will answer individual questions concerning CAI programs at colleges and universities. In addition, MISCAICH plans to publish a catalog of available CAI programs in fall 1981. While the focus of this project is on minority institutions, neither the intent nor the actions of the project are limited to them.

Smith, Stanley G., and Sherwood, Bruce. "Educational Uses of the PLATO Computer System." *Science* 192: 344-352.

Smith and Sherwood, both of the University of Illinois at Urbana-Champaign, describe the PLATO network of computer-assisted instruction, research, and communication developed at that school in the 1960s and disseminated worldwide. The article focuses on PLATO as it is used to facilitate learning in the sciences, and provides examples of how PLATO functions in various educational capacities.

Spencer, Donald D. *Computer Dictionary for Everyone*. New York: Charles Scribner's Sons, 1979.

Using nontechnical language Spencer explains the meaning of approximately 2,500 words, phrases, and acronyms used in connection with computers. The definitions are concisely and simply stated for terms ranging from absolute coding and batch processing to time sharing and zero suppression. This book is a handy reference tool for anyone interested in learning computer terminology and in understanding more about computers.

CLARIFICATION of last month's feature article on Yale University's Writing Program: The Pew Memorial Trust granted funds in 1976 to the university, which in turn allocated the money towards the formation of a Committee on Expository Writing; tutors who assist students with Daily Themes and other writing assignments receive stipends from the university. For more information, contact:

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The Forum for Liberal Education

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The Forum for Liberal Education is a topic-oriented publication featuring a subject of importance for liberal education in each issue. It does not endorse or evaluate institutional activity. Rather, it describes various ways in which institutions of higher learning address important common concerns. Upcoming issues of the *Forum* will look at women's studies, Project Lodestar, and graduate liberal studies. **Contributions of program information from *Forum* readers are encouraged.**

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